APPARATUS FOR CUTTING AND STIRRING CURD

This application is a continuation of Ser. No. 09/659,994, filed Sep. 12, 2000, now U.S. Pat. No. 6,257,129.

This invention relates to an apparatus for cutting and stirring curd. Such apparatuses are known from practice and comprise a tank in which a rotatable shaft is situated which carries cutting frames extending radially from the shaft, which cutting frames are mounted on the shaft in staggered relation. The cutting frames each comprise two spaced-apart parallel frame girders, which are mounted by one end on the rotatable shaft and whose other end extends to a point near the wall of the tank. The tank can be arranged horizontally or vertically, the rotatable shaft then being likewise horizontal or vertical.

Arranged between the frame girders is a lattice of longitudinal and transverse knives. The transverse knives extend transversely to the frame girders and are welded to them. The longitudinal knives extend parallel to the frame girders and are mounted on the transverse knives by welding.

Such an apparatus is, for instance, the curd vat marketed by Tetra Pak Tebel under the name of OST4. Such an apparatus is also described, for instance, in U.S. Pat. No. 4,108,058. A variant with two horizontal shafts in a horizontal oval tank is described in U.S. Pat. No. 4,989,504.

All known apparatuses are arranged for stirring and cutting curd which has formed in the tank in that the tank has been filled with milk to which starter and rennet have been added. To that end, the central shaft is driven for rotation, so that the cutting frames move through the curd formed. The cutting frames are usually designed such that the knives and the frame girders form a cutting edge along one edge and are blunt and rounded off along the other edge. Accordingly, rotation of the central shaft(s) in one direction substantially yields a cutting action, while rotation in the other direction substantially yields a stirring action.

A problem presenting itself in the known apparatuses is that they comprise many welds, which must all be polished very well to prevent accumulation of contaminants and bacterial growth. The longitudinal knives can be arranged, for instance, with interspaces of the order of 4 to 5 cm and the transverse knives with interspaces of, for instance, 14.5 to 17.5 cm. A cutting frame can, for instance, have a total width of the order of 50 cm and a length of, for instance, 150 cm. This means that a single cutting frame can comprise, for instance, about 100 rectangular lattice openings, each having four corners where a longitudinal knife or a frame girder is welded to a transverse knife. Each of those welds not only needs to be provided, but also needs to be accurately polished to satisfy the requirements set by government regulations with regard to cleanability. For the welding operation, and in particular also for the polishing operation, however, little space is available within the lattice openings formed by the longitudinal and transverse elements of a cutting frame. As a consequence, the welding work and the polishing work are very time consuming and costly.

In the past, it has been proposed to make the cutting frames of detachable design to obtained a better cleanability. A major drawback of such a solution is that each time a curd vat is to be cleaned, time consuming and cumbersome dismounting activities are necessary.

Accordingly, there is a need for an apparatus of the above-described kind, having a construction such that the necessary welling and polishing work is considerably reduced and simplified, while yet an effective cutting and stirring action and an excellent cleanability remain guaranteed.

According to the invention, to that end, an apparatus for cutting and stirring curd, comprising a curd vat with a shaft drivable for rotation, which shaft carries a number of cutting frames extending radially from the shaft and mounted on the shaft in staggered relation, each cutting frame having frame girders which extend radially from the drivable shaft and between which a lattice work is situated formed from longitudinal knives and transverse knives, the transverse knives being mounted on the frame girders by welding, is characterized in that the transverse knives form openings which are in line, in which the longitudinal knives are received with ample play, and means are provided to substantially prevent displacement of the longitudinal knives in the longitudinal direction.

In the following, the invention will be further described with reference to the accompanying drawings.

FIG. 1 schematically shows in longitudinal cross section an example of a known apparatus for cutting and stirring curd;

FIG. 2 schematically shows the apparatus of FIG. 1 in cross section;

FIG. 3 schematically shows in top plan view an example of a known cutting frame for an apparatus for cutting and stirring curd;

FIG. 4 schematically shows an end view of the cutting frame of FIG. 3;

FIG. 5 schematically shows a section along the line V—V in FIG. 3;

FIG. 6 schematically shows a top plan view of an example of a cutting frame according to the invention;

FIG. 7 schematically shows a side elevation of the cutting frame of FIG. 6; and

FIG. 8 schematically shows a cross section along the line VIII—VIII in FIG. 6;

FIG. 9 shows a detail of the cutting frame of FIG. 6;

FIGS. 10 and 11 schematically show examples of the manner in which a transverse knife of a cutting frame according to the invention can receive a longitudinal knife;

FIG. 12 schematically shows a few examples of shapes of a bent longitudinal knife;

FIG. 13 schematically shows an example of a bent transverse knife;

FIGS. 14 and 15 schematically show in side elevation and top plan view an example of a fixing method for a longitudinal knife;

FIGS. 16 and 17 schematically show in top plan view and side elevation an example of an alternative fixing method for a longitudinal knife; and

FIG. 18 schematically shows in top plan view a few examples of shapes of the free end of a longitudinal knife.

FIGS. 1 and 2 represent a known cylindrical horizontally arranged curd vat 1 which is supported by a number of legs 2. The end walls 3, 4 of the curd vat 1 are conical in this example and through one of these end walls a shaft 5 extends centrally into the curd container. This shaft, which in this example is journaled in the opposite end wall, supports a tool 6 for cutting and stirring curd in the curd container. Numeral 7 designates a sealing element between the shaft 5 and the wall 3, through which the shaft 5 extends into the curd container.

Outside the curd container, the shaft 5 is connected by means of a coupling 8 to a shaft 9, which is connected, in most cases coupled directly via transmission means 10, to a drive motor 11. The motor 11 is arranged for rotating the tool 6 around the centerline of the curd vat 1 alternately in one direction and the other.

In this example, the curd vat 1 in its upper part has a manhole 13 which is covered by a manhole cover 13*a*. In

this example, further, another opening is provided in the upper part of the curd container 1, which opening is designated by 14 and is intended for the immersion of a whey sieve 15 in the curd container 1. The whey sieve 15 in this example is supported by a bent pipe 16 which at 17 is rotatably connected to the curd container 1. The curd vat 1 has an outlet 18 at its lowest part. A triangle P indicates a usual level of the curd in the curd vat. It is noted that the invention is also applicable to differently designed curd vats.

The tool 6 comprises a number of cutting frames 19 which are located side by side along the shaft 5, as appears from FIG. 1. In the illustrated embodiment, the tool consists of six sections. The number of sections is dependent on the size of the tank. The sections are connected to the shaft, such that they form angles with each other, as can be seen in FIG. 2. In the illustrated embodiment, the sections are placed along the shaft 5 so as to extend outwards from the shaft in a helical configuration.

Each of the sections may further be fitted at an angle to the shaft 5, as illustrated in FIG. 1 by a broken line 20 indicating the section which is located farthest to the left and is concealed by the shaft 5.

FIGS. 3 and 4 schematically show in top plan view and end view an example of a known cutting frame 19, as can be used, for instance, in the apparatus of FIGS. 1 and 2. The known cutting frame comprises two parallel frame girders 21, between which transverse knives 22 extend transversely to the longitudinal girders 21, which transverse knives 22 are welded to the frame girders. Extending transversely to the transverse knives 22 and parallel to the frame girders are longitudinal knives 23, which are welded to the transverse knives. The longitudinal girders, the transverse knives and the longitudinal knives are provided, on one longitudinal edge thereof, with a cutting edge 24, and 25 (FIG. 5), all situated on the same side with respect to the cutting frame. The other longitudinal edge in each case is blunt and typically of rounded design. The sharp teeth serve for cutting the curd in one rotational direction of the shaft 5 and the blunt edges serve for stirring the curd in the other rotational direction.

It is noted that in FIG. 3 the longitudinal knives are longer than the frame girders. In reality, however, the frame girders, at least on the side of the rotatable shaft 5, whose axis is indicated in FIG. 3 at 27, either extend as far as the rotatable shaft or are connected with the rotatable shaft through suitable extension pieces adapted, for instance, for receiving the free ends of the frame girders.

FIG. 5 schematically shows a cross section along the line V—V in FIG. 3. Indicated at 28 and 29 are the welds between the transverse knives and the longitudinal knives, and between the frame girders and the transverse knives, respectively. Each lattice opening of the lattice shown in FIG. 3, formed by the transverse and longitudinal knives and the frame girders, comprises four welds, which are all to be polished to remove cavities and roughnesses. Nor should the welds exhibit any cracks. Providing and finishing these welds is a highly labor intensive, cumbersome and costly work, as has already been set out in the foregoing.

FIG. 6 schematically shows in top plan view an example of a cutting frame for an apparatus according to the invention, and FIG. 7 schematically shows a side view of the cutting frame of FIG. 6, and FIG. 8 is cross-section taken on line VIII—VIII in FIG. 6. The cutting frame shown can be mounted, in a manner similar to the known cutting frames, on a central rotatable shaft 5, the centerline 27 of which is indicated in FIG. 6. The cutting frame shown again comprises two substantially parallel frame girders 30, 31, between which extend knives 32 in transverse direction. The frame girders again have a sharp cutting edge 33, which is situated on the upper side in FIG. 7, and a blunt, in this example rounded, lower edge. The transverse knives 32 also have corresponding cutting edges 35 and blunt edges 36. Optionally, however, the transverse knives and/or the longitudinal knives may also have a cutting edge on both sides. The transverse knives are connected at their ends to the frame girders in a conventional manner by welds 37. The transverse knives are further each provided with a series of openings uniformly distributed along the length of the transverse knives. Mach opening of a transverse knife is in register with corresponding openings of the other transverse knives, and the openings are so designed that a longitudinal knife can be slid into them. The longitudinal knives are loosely disposed in the openings with a relatively large play. This prevents accumulation of curd material at the intersections of transverse and longitudinal knives and provides for good cleanability. The longitudinal knives, therefore, are not fixedly connected to the transverse knives and can be assembled in a simple manner by sliding them into the openings of the transverse knives. Subsequently, the longitudinal knives are jointly secured with one or more transverse pins in a manner yet to be described, or in a different manner.

The openings in the transverse knives can have various shapes, for instance a circular, oval, rectangular or diamond-shaped shape. The edges of the openings, or at least the lower portion thereof, can be provided with cutting edges. Advantageously, the upper edges, or all edges, of the openings may also be sharp so as to obtain a smallest possible contact surface and a smallest possible risk of dirt incrustation.

Examples of receiving openings for a longitudinal knife as provided in a transverse knife are schematically shown in FIGS. 10 and 11, each showing two side-by-side openings 60 and 61, respectively, in which a U-shaped bent longitudinal knife 38 is received.

To enhance strength, the transverse knives can optionally have a curved or bent shape, as viewed in cross section, as shown schematically in FIG. 13. The transverse knife shown in cross section has a lower part 50 and an upper part 51, which include an angle α of, for instance, 160° or 170°.

In the exemplary embodiment schematically shown in FIGS. 7 and 8, there are used two rows of transverse knives or transverse elements 32*a*, 32*b* placed above each other with an interspace D, two transverse knives or transverse elements located above each other jointly forming a complete transverse knife. The upper transverse knife 32*a* has an upper cutting edge 35. The lower transverse knife 32*b* in the example shown does not have a cutting edge at the top, but could have one, if desired. Further, both transverse knives of each set in this example are blunt on the lower side. The designations upper side and lower side are related to FIG. 8 and respectively indicate the leading and trailing side during the cutting of the curd. The distance D between the transverse knives located above each other is less than the height of the longitudinal knives 38. To enable the longitudinal knives to be received and locked against lateral displacement, there are provided in the transverse knives series of opposite recesses 39, 40 which in the example shown in FIG. 8 have approximately the shape of a truncated triangle. Two opposite openings can jointly receive a longitudinal knife 38. The cutting edge 41 of the longitudinal knives is turned upwards in FIG. 8. The longitudinal knife has some possibility of movement within the opening 39, 40 both in vertical direction and in horizontal direction, as